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(71) Applicants
David Charles Hammond,
Duart,
Bulstrode Lane,
Felden,
Hemel Hempstead,
Herts.
(72) Inventors
David Charles Hammond
(74) Agents
J.F. Williams & Co.,
34 Tavistock Street,
London WC2E 7PB.

(54) **Deep hole drill bit, manufacture and use thereof**

(57) The bit comprises a hollow one piece tube (1) and a cutting tip (3) brazed to one end of the tube (1), the cutting tip (3) being apertured to provide an outlet (7) from the one piece hollow tube (1) and the one piece hollow tube (1) having a swarf clearance flute of 180° or more, i.e. is of D-shaped cross-section. The one-piece tube is pressed into the required shape from an original circular cross-section. The tube has a circular end fixed to a holder (2). For larger diameters, the tube contains an inner tube (9). In use, the drill is supplied with an air/oil mist for cooling and lubrication.

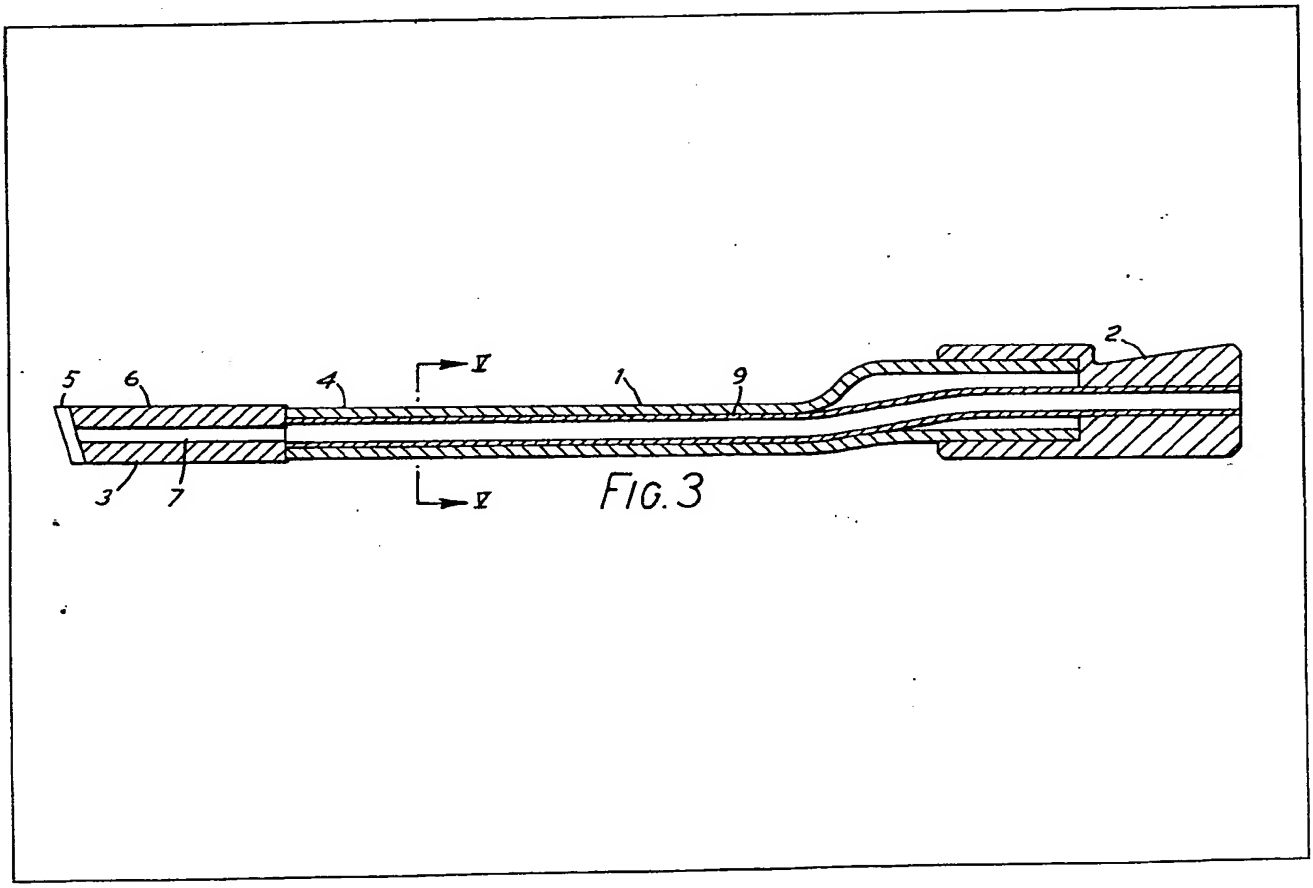

FIG. 3

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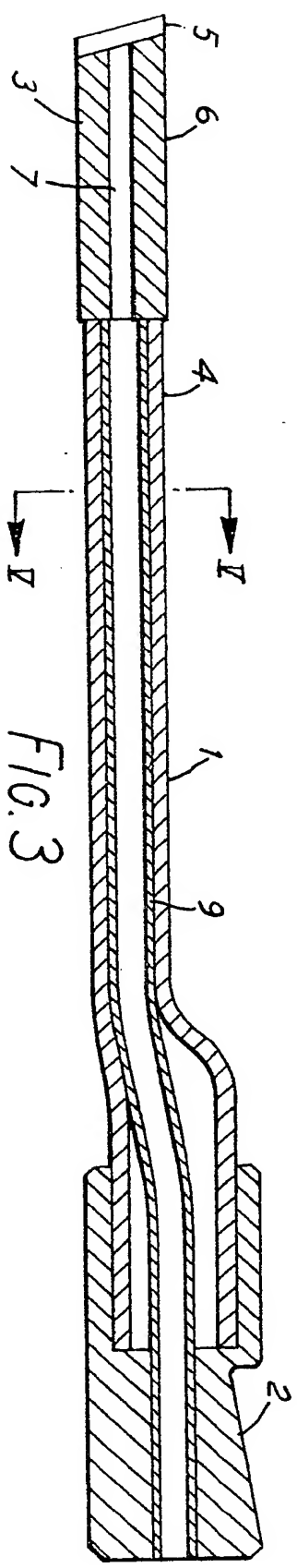

FIG.3

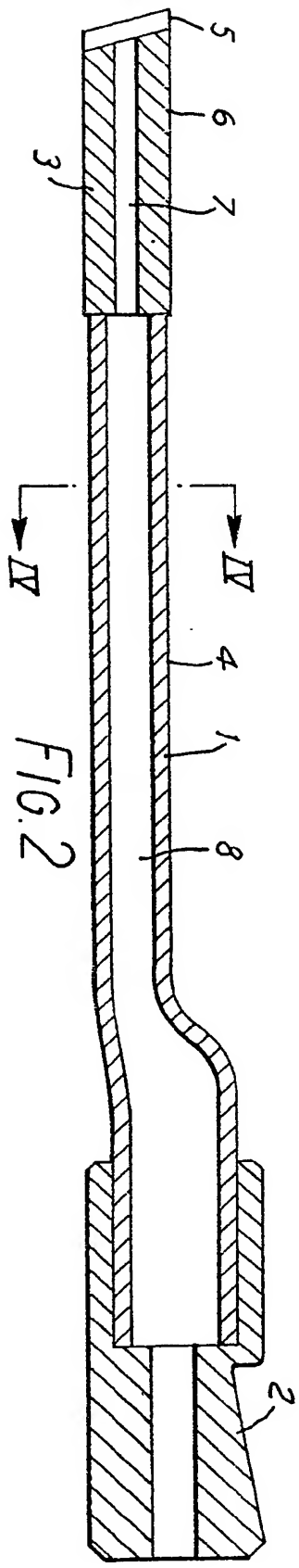

FIG.2

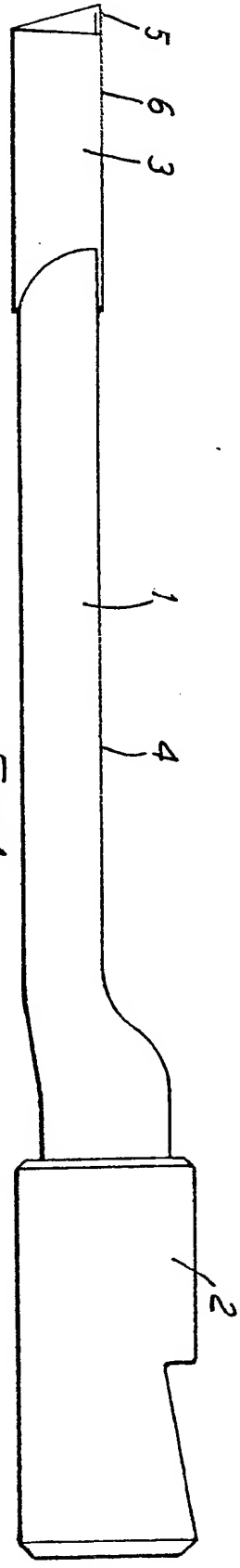

FIG.1

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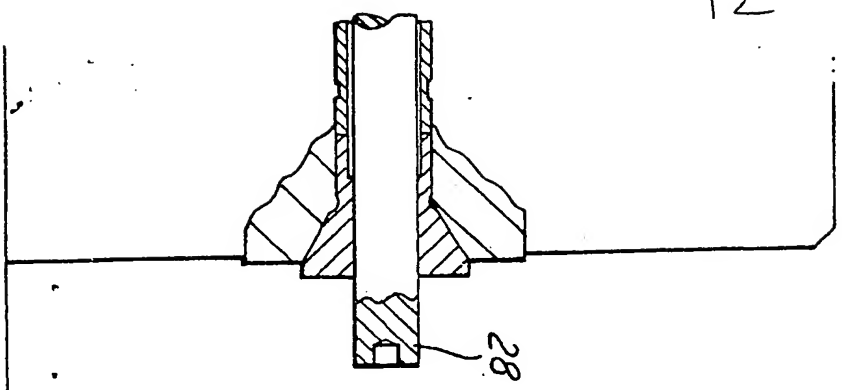

FIG.4

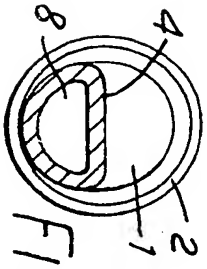

FIG.5

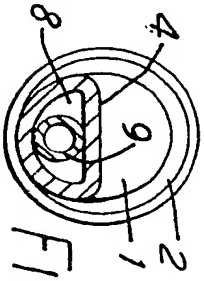

FIG.6

SPECIFICATION

Drill bit and manufacture and use thereof

This invention relates to a drill bit and particularly to a drill bit usuable for deep hole drilling. It also relates to a method of making such a drill bit and a method of drilling using such a drill bit.

Up to now there have been significant problems in drilling holes which are of depths greater than 5 times the hole diameter. Up to this point, relatively common and cheap drills, such as twist drills, can be employed without the necessity of employing expensive technology or without having to slow down the drilling operation.

With a bore depth of up to 5 times the diameter, the hole can be drilled fast with a normal twist drill but if the depth exceeds five times the diameter, because of the stringy swarf produced, it is necessary to keep removing the drill in order to clear the swarf from the channels of the drill bit. Thus drilling proceeds with a so-called "pecking action".

It has been proposed to provide an oil feed for such twist drills, the bits having an oil gallery through the length of the flute enabling cooling fluid to be pumped to the cutting edges. This however, does not deal with the disadvantage of the formation of a stringy swarf and again a pecking action is necessary.

The usual method of drilling deep holes comprises using gun drills. These gun drillls usually consist of a hollow steel tube with an attached tungsten carbide cutting head. A coolant/lubricant is supplied under high pressure (up to 1,000 psi of 70kg/cm^2) through the centre of the drill to the single edge of the cutting tip and with this high pressure, the swarf is formed with a chip formation and is swept back by way of a swarf clearance flute on the outside of the drill. The drilling action of these drills is good and provides a high surface finish in the bore owing to the configuration of the tungsten carbide tip with associated burnishing pads. However, gun drills cannot be used with ordinary lathes or drilling machines as special machinery is required. In particular there is the necessity of providing equipment for supplying the coolant under high pressure and the necessity of totally enclosing the machining area because of the pressure with which the swarf is washed out. Furthermore, the cost of producing the gun drill bit itself is high due to the relative difficulty in producing the kidney shaped configuration of the tip and tube of the gun drill.

The present invention seeks to provide a deep hole drilling bit in which some or all of the above mentioned disadvantages are obviated or substantially reduced.

According to a first aspect of the invention, a deep hole drill bit comprises a hollow one piece tube, and a cutting tip attached to one end of the tubes, the cutting tip being apertured to provide an outlet from the one piece hollow tube and the one piece hollow tube having a swarf clearance flute of 180° or more.

An inner tube may be provided within the one piece hollow tube for supplying lubricant/coolant to the cutting tip. The cutting tip and the lubricant feed channel thereto may be constructed to provide an outlet for atomised lubricant/coolant. Preferably the hollow tube is of "D" shaped configuration with the flat side of the "D" extending approximately along the rotary axis of the drill bit.

According to a second aspect of the invention, a method of manufacturing a deep hole drill bit comprises press forming a cylindrical or substantially cylindrical tube into the desired configuration and attaching a holder at one end of the tube and a cutting tip at the other end.

Prior to the attachment of the holder and cutting tip, a smaller diameter tube must be inserted through the formed tube and may also be connected to the holder and cutting tip. The cylindrical tube may be formed into a D shaped configuration over the major part of its length with the flat of the D extending approximately along the axis of the remainder of the tube.

According to a third aspect of the invention, a method of drilling deep holes comprises drilling the hole with a drill bit comprising a hollow one piece tube and a cutting tip attached to one end of the tube, the cutting tip being apertured to provide an outlet from the one piece hollow tube and the hollow tube having a swarf clearance of 180° or more and supplying to the hollow tube a lubricant/coolant in the form of a mist at low pressure.

The mist may comprise a mixture of soluble drilling oil and water.

The invention will now be described in greater detail, by way of example, with reference to the drawings in which:-

Figure 1 is a side view of a first form of drill bit in accordance with the invention;

Figure 2 is a sectional view showing the formation of the interior of the drill bit in Figure 1.

Figure 3 is a view similar to Figure 2 but showing the drill bit with an inner tube for drill bits of larger diameter;

Figure 4 is a sectional view taken on the line IV-IV of Figure 2;

Figure 5 is a sectional view taken along the lines V-V of Figure 3.

Figure 6 is a diagrammatic view showing the use of a drill bit in accordance with the invention in a typical single spindle automatic lathe.

Referring firstly to Figures 1 and 2, it will be seen that the deep hole drilling bit comprises a hollow tube 1 extending from a holder 2 into a cutting tip 3 suitably fastened to the end of the tube 1. The tube has a D-shaped configuration so that the flat side of 4 of the tube 1 extends approximately along the axis of the hole which is to be made, the cutting edge 5 and the face 6 of the cutting element lying exactly on the centre line of the diameter. Typically the cutting tip 3 is provided with burnishing pads. As can be seen from the sectional view, the cutting tip 3 is provided with a longitudinal passage 7 which has a reduced diameter compared to the free space 8 within the tube 1 and forms a nozzle-like configuration through which cooling and lubricating fluid can flow usually in the form of a mist. It will also be seen that the D shaped portion of the tube extends to adjacent the holder 2, at which point it becomes circular.

In manufacturing the drill bit, the hollow tube is suitably produced from a circular cross section chrome molybdenum steel tube. The exact configuration desired is produced by a pressing operation using suitable dies. By this means, the D shaped configuration can be produced so that the flat of the D lies on the axis of the original tube and the original tube can be maintained at one end so as to enable ready attachment of the tube into the holder 2. In this way, centering problems are reduced or eliminated. At the other end of tube 1, a tungsten carbide tip 3 is attached. The attachment of the tip 3 and the holder 2 to the tube 1 is preferably achieved by brazing.

The pressing of the steel tube enables an easy and cheap fabrication method using a standard tube and avoids the necessity of rolling or otherwise shaping of the tube with consequent defects which are created and which have to be connected. It will also be observed that there is a saving of the materials used in that, because of the pressing operation the drill portion is of larger diameter than the original tube due to the redistribution of the material.

Other material may be used, the above being only examples, such other materials including stainless steel.

This construction is suitable for small to medium diameter bits. With larger diameter bits, the size of the passage in the tube 1 is too large to provide the desired flow of mist, without condensation, to the desired small nozzle boring or passage 7 in the cutting tip 3. In such a bit, an annular liquid carrying tube 9 is provided as shown in Figures 3 and 5. This tube 9 is suitably swaged into the holder 2 at one end and is suitably brazed or welded to the cutting tip at its other end.

The drill bit can be used with many types of lathes or drilling equipment and one suitable arrangement for use of this drill bit is shown in Figure 6.

The drill bits constructed as desired above may, for example, be used with an unsupported length up to 30 times its diameter or, with intervening support, there is no theoretical limit. The supply of cooling/lubricant mist may suitably comprise soluble drilling oil which is mixed with water. It is preferable to use a mist device which, for example, provides an inlet mist into the bit passage. This mist may use a mix of ten parts of water to one part of soluble extreme pressure oil and may be used at any pressure from about 15 psi (1kg/cm^2) up to, for example 80 psi (5.5Kg/cm^2) through higher pressure may be used. It has been found that between 40 and 50 psi (3 and 3.5kg/cm^2) gives optimum results. Normal diameters of the drill would be in the range 3mm to 35mm.

Figure 6 shows a suitable setup for using a drill bit in accordance with the invention. Here there is shown an outline of a typical turret-slide arrangement for single spindle automatic lathe.

With this lathe it is intended that the work piece 20 should be rotated and the drill bit 21 should remain stationary. For the purpose of installation of the drill bit 21, a special tool holder 22 is provided having a suitable passage 23 for the lubricant/coolant mist for connection to the passage way within the drill bit 21. Also attached to the tool holder 22 is a suitable chip/spray deflector 24 for receiving and deflecting the returned lubricant/coolant and in particular the swarf generated by the drilling operation. As stated, the drill bit 21 is supplied with a mist and for this purpose a pressure unit 25 is provided for delivering the air/coolant mixture as a spray. The output of the spray, which is under pressure, is controlled by a control valve 26 which controls the feed of the air/oil mist through a separate supply pipe 27 to the tool holder.

With arrangement set up as shown, the drill bit can be used for drilling relatively deep holes in the workpiece 28 at relatively high speed without the need for a pecking action, adequate cooling and lubrication being provided by the air/oil mist. The oil is to a large extent effectively used up during the drilling operation and thus does not provide large amounts of returning liquid and keeps the operation relatively clean. However, there is sufficient pressure in the air/oil mist to provide for the forcing of the swarf down the relatively large channel left for swarf clearance.

While the lathe shown in Figure 6 uses a stationary drill bit and a rotating workpiece, it is of course possible to use a rotating drill bit and a stationary workpiece.

From the above it will be seen that the invention provides a deep drilling bit which is suitable for use with minimum adaptation in typical lathes and like drilling machines without the necessity of providing expensive technological equipment for its use nor the necessity or providing a high pressure lubricant supply.

The method of manufacture of the drill bit provides a particularly simple and inexpensive manufacturing process.

CLAIMS

1. A deep hole drill bit comprising a hollow one piece tube, and a cutting tip attached to one end of the tube, the cutting tip being apertured to provide an outlet from the one piece hollow tube and the one piece hollow tube having a swarf clearance flute of 180° or more.

2. A drill bit as claimed in claim 1, wherein an inner tube is provided within the one piece hollow tube for supplying lubricant/coolant to the cutting tip.

3. A drill bit as claimed in claim 1 or 2, wherein outlet at the cutting tip and the lubricant feed channel thereto are constructed to provide an outlet for atomised lubricant/coolant.

4. A drill bit as claimed in claim 1, 2 or 3, wherein the lubricant/coolant is fed to the bit at low pressure.

5. A drill bit as claimed in claim 1 or 2 wherein the lubricant/coolant is fed into the drill bit in the form of a mist.

6. A drill bit as claimed in any one of claims 1 to 5, wherein the hollow tube is of "D" shaped configuration with the flat side of the "D" extending approximately along the rotary axis of the drill bit.

7. A drill bit as claimed in any one of the preceding claims, wherein the hollow tube is shaped from a circular tube into a "D" shape by forming with dies in a press.

8. A method of manufacturing a deep hole drill bit comprising press forming a cylindrical or substantially cylindrical tube into the desired configuration and attaching a holder at one end of the tube and a cutting tip at the other end.

9. A method as claimed in claim 8, wherein prior to the attachment of the holder and cutting tip, a smaller diameter tuber is inserted through the formed tube and is also connected to the holder and cutting tip.

10. A method as claimed in claim 8 or 9, wherein the cylindrical tube is formed into a D shaped configuration over the major part of its length with the flat of the D extending approximately along the axis of the remainder of the tube.

11. A method as claimed in any one of claims 8 to 10, wherein the tube is formed of chrome molybdenum steel and is braized to a steel holder at one end to a tungsten carbide cutting tip at the other end.

12. A method of drilling deep holes comprising drilling the hole with a drill bit comprising a hollow one piece tube and a cutting tip attached to one end of the tube, the cutting tip being apertured to provide an outlet from the one piece hollow tube and the hollow tube having a swarf clearance of 180° or more and supplying to the hollow tube a lubricant/coolant in the form of a mist at low pressure.

13. A method as claimed in claim 12, wherein the mist comprises a mixture of soluble drilling oil and water.

14. A method as claimed in claim 12 wherein the mixture comprises ten parts of water to one part of soluble extreme pressure oil.

15. A method as claimed in any one of claims 12 to 14, wherein the pressure of mist supply is between 15 psi (1 kg/cm^2) and 80 psi (5kg/cm^2).

16. A method as claimed in claim 15 wherein the pressure of the mist supply is between 40 and 50 psi (3 and 3.5 kg/cm^2).

17. A deep hole drill bit substantially as described herein with reference to the drawings.

18. A method of manufacturing a deep hole drill bit substantially as described herein with reference to the drawings.

19. A method of drilling a deep hole substantially as described herein with reference to the drawings.

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